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Selected Bibliography of Statistical Literature, 1930 to 1957: II. Time Series

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This is the second in a series of bibliographies dealing with various specific subjects in the field of statistics. References and titles of important contributions to the study of time series have been taken from a wide variety of technical journals published in the many languages and countries which have been actively engaged in statistical analysis.

If this series of subject-classified bibliographies can assist the overburdened statistician to keep abreast of the great abundance of literature in his field, our aim has been accomplished. Although the coverage of technical journals is worldwide, each bibliography is still far from complete. The books and articles considered by two prominent reviewing journals to be of sufficient statistical importance to include in their regular abstracting services form the source material for these classified bibliographies.

This particular subject classification on *Time Series* follows the earlier and closely related one on *Correlation and Regression Theory*.[1] The titles and references are extracted from a card file made up of abstracts taken from *Zentralblatt für Mathematik* for the years 1930 to 1939, and from *Mathematical Reviews* from 1940 through 1957. The file of abstracts is maintained on a current basis in the NBS Statistical Engineering Laboratory; the bibliographies extracted from it are necessarily delayed due to loss of time in processing, editing, and publishing.

The following information comes directly from the abstracts:

Author: The author's surname is followed by initials only. In the case of complicated surnames, the first capitalized word given in the reviewing journal is used. When the paper bears the names of more than one author, the journal reference appears with each author's name, but the title of the paper is given with the senior author only. Multiple authorship is denoted by the symbol ♦ preceding the surname.

Title: Given exactly as in the reviewing journal. Titles of separately bound publications (books, reports, etc.) are italicized, and are followed by the publisher.

Reference to literature: In many cases the abbreviations of journal names have been necessarily severe and unconventional. The name of the journal in italics and the number of the volume in boldface, are followed by the initial page number.

Date of publication: The next figure shows the date in parentheses in which the article or book itself appeared.

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WASHINGTON, D.C. (Paper 64B1–23)

Publications of the National Bureau of Standards*

(Including Papers in Outside Journals)

Selected Abstracts

Use of Chebychev polynomials in thin film computations, K. D. Mielenz, *J. Research NBS* **63A,** *No. 3, 297 (1959).*

From Herpin's expression for the mth power of a multilayer matrix, very simple closed formulas are derived for the matrices and optical constants of any multilayer with a periodic structure.
According to Epstein's theorem, any symmetrical multilayer is equivalent to a fictitious monolayer. A simple expression for the equivalent index and thickness of this monolayer is deduced for the case of a periodic and symmetrical sequence of equally thick films.
As compared to any other method of numerical computation, the suggested formulation provides a considerable saving of time and work. In a numerical example, this saving amounts to about 80 percent.

Theory of formation of polymer crystals with folded chains in dilute solution, J. I. Lauritzen, Jr., and J. D. Hoffman, *J. Research NBS* **64A,** *No. 1, 73 (1960).*

A detailed interpretation of the kinetics of homogeneous nucleation and growth of a polymer from dilute solutions is given. The probability of forming both nuclei with folded chains, and the conventional bundle-like nuclei, from dilute solution is carefully analyzed. It is predicted that at sufficiently high dilution, critical nuclei of length $\mathbf{l}^*$ will be formed from single polymer molecules by sharp folding of the chain backbone. After growth, the resulting crystal is flat and platelike, the loops formed by the chain folds being on the upper and lower surfaces. Kinetic factors determine that the distance between the flat surfaces in the grown crystal will vary over only a narrow range of values about a characteristic step height, $\mathbf{l}^*=\sigma_e/\Delta\mathbf{f}$. Here σ_e is the free energy required to form a unit area of the flat surface, and possesses a rather large value because the work involved in forming folds is included. The quantity $\Delta\mathbf{f}$ is the free energy difference per unit volume of crystal between the crystalline and solution states, and is approximately proportional to the degree of supercooling, $\Delta\mathbf{T}$. These crystals are metastable. The logarithm of the nucleation rate is approximately proportional to $1/(\Delta\mathbf{T})^2$ near the melting point. The exponent n in the free growth rate law is predicted under various assumptions. To the extent that comparison is possible, the predictions given agree with the experimental results obtained by Keller and O'Connor and others on single crystals of unbranched polyethylene grown from dilute solution.

Effect of antenna size on gain, bandwidth, and efficiency, R. G. Harrington, *J. Research NBS* **64D,** *No. 1, 1 (1960).*

A theoretical ana'ysis is made of the effect of antenna size on parameters such as gain, bandwidth, and efficiency. Both near-zone and far-zone directive gains are considered. It is found that the maximum gain obtainable from a broadband antenna is approximately equal to that of the uniformly illuminated aperture. If higher gain is desired, the antenna must necessarily be a narrow-band device. In fact, the input impedance becomes frequency sensitive so rapidly that, for large antennas, no significant increase in gain over that of the uniformly illuminated aperture is possible. Also, if the antenna is lossy, the efficiency falls rapidly as the gain is increased over that of the uniformly illuminated aperture.

Surface-wave resonance effect in a reactive cylindrical structure excited by an axial line source, A. L. Cullen, *J. Research NBS* **64D,** *No. 1, 13 (1960).*

It is shown that a purely reactive cylinder excited by a neighboring line source can, under suitable conditions, give rise to a radiation pattern closely approximating the function $\cos n\,\theta$.
In a numerical example, a cylinder of three transverse electromagnetic wavelengths circumference has a surface reactance chosen to emphasize the term $\cos 6\,\theta$ in the Fourier series of the resultant radiation pattern. It is shown that only 1.1 percent of the total power delivered to the line source is radiated in unwanted modes.
It is also shown that the position of the line source does not affect this result to first order provided that $k(b-a)<<1$, where $b-a$ is the distance of the line source from the cylindrical surface.

An exact earth-flattening procedure in propagation around a sphere, B. Y. -C. Koo and M. Katzin, *J. Research NBS* **64D,** *No. 1, 61 (1960).*

By a refinement of the procedure used in the usual earth-flattening approximation, the problem of propagation around a spherical earth is reduced to an exact equation of the same form. Thereby the earth-flattening procedure becomes applicable to arbitrarily large heights and distances. It is also found that existing solutions of the approximate equations can be reevaluated to yield the exact solutions for slightly different refractive index distributions.

Some applications of statistical sampling methods to outgoing letter mail characteristics, N. C. Severo, A. E. Newman, S. M. Young, and M. Zelen, *NBS Tech. Note 16 (PB151375) $2.75.*

This paper presents applications of statistical sampling procedures especially devised to procure information about the characteristics of outgoing letter mail. The results of four separate studies carried out in the Washington, D.C., San Francisco, and Los Angeles post offices are herein summarized. The techniques used in the various studies were developed so that the required information would be of predetermined reliability and could be gathered without the use of a large staff and without interrupting the flow of mail. The four studies presented concern: (1) Letter size and color characteristics, (2) ratio of hand canceled mail to machine canceled mail, (3) top and bottom clearance space of an addressed envelope, (4) proportions of long and short letters.

Terrestrial propagation of very-low-frequency radio waves, J. R. Wait, *J. Research NBS* **64D,** *No. 2, 153 (1960).*

A self-contained treatment of the wave-guide mode theory of the propagation of very-low-frequency radio waves is presented. The model of a flat earth with a sharply bounded and homogeneous ionosphere is treated for both vertical and horizontal dipole excitation. The properties of the modes are discussed in considerable detail.
The influence of earth curvature is also considered by reformulating the problem using spherical wave functions of complex order. The modes in such a curved guide are investigated and despite the initial complexity of the general solution, many interesting and limiting cases may be treated in simple fashion to yield useful and convenient formulas for calculation.

Other factors considered are the influence of the earth's magnetic field, antipodal effects, resonator type oscillations, and the influence of stratification at the lower edge of the ionosphere.

Inclusion theorems for congruence subgroups, M. Newman and I. Reiner, *Trans. Am. Math. Soc.* **91,** *No. 3, 369 (1959).*

Let G_t be the group consisting of all $t\times t$ integral matrices of determinant 1. For a fixed partition $t=r+s$ of t into positive integers r, s, and for a fixed positive integer n, define the subgroup

$$G_{r,s}(n)=\left\{\begin{pmatrix} A^{(r)} & B \\ C & D^{(s)}\end{pmatrix}\epsilon G_t\colon\ C\equiv 0 \pmod n\right\}.$$

Suppose that m is a positive integer and H a group such that

$$G_{r,s}(mn)\subset H\subset G_{r,s}(n).$$

Then

$$H=G_{r,s}(dn) \text{ where } d|m.$$

Further results of this type are obtained.

New approach in the theory of satellite orbits, J. P. Vinti, *Phys. Rev. Letters* **3,** *No. 1, 8 (1959).*

A gravitational potential has been found, expressed in oblate spheroidal coordinates, which results in separability of the Hamilton-Jacobi equation for the motion of an earth satellite and which is much closer to the empirically accepted one than any heretofore used as the starting point of a calculation. It thus becomes possible to do orbit theory for unretarded satellites very accurately without the use of perturbation theory.

Calculated patterns of slotted elliptic-cylinder antennae, J. R. Wait and W. E. Mientka, *Appl. Sci. Research* **B7,** *449 (1959).*

The model assumed is a perfectly conducting elliptic cylinder of infinite length which has a narrow axial slot of finite length. Patterns are presented for various ratios of the major to minor axis. It is indicated that for reasonably large elliptic cylinders, the patterns are dependent mainly on the surface curvature in the neighborhood of the slot.

On prediction of system behavior, J. R. Rosenblatt, *Proc. of the N.Y. Univ.–Ind. Conf. on Reliability Theory (New York, N.Y.) p. 39 (1958).*

It is customary in theoretical discussions of prediction of system performance to assume that the relation between variables by which performance is assessed and variables describing the parts of the system can be specified by a function. The purpose of this paper is to consider some of the problems which arise in choosing the form of such a function and in specifying the relevant variables and the nature of appropriate experiments, measurements, and data.
In the context of each of a number of familiar types of mathematical model, the possible consequences of alternative choices of time units, subsystem definitions, and independence assumptions are discussed.

Kinetic equation for a plasma with unsteady correlations, C. M. Tchen, *Phys. Rev.* **114,** *394 (1959).*

As a generalization of the Boltzmann equation, the kinetic equation for a plasma is derived in the form of a generalized Fokker-Planck equation, by considering unsteady correlations, including non-Markovian and nonlinear behavior. Both the binary and ternary correlations are used for many kinds of particles with different temperatures. The coefficients of the kinetic equation depend on the law of interaction for a pair of particles and are influenced by relaxation. The effective potential of friction consists of two parts: the static part corresponds to the Debye potential and is isotropic, the dynamical part is axially symmetrical about the direction of motion, and causes a dynamical friction. The results show that the friction is proportional to velocity for slow particles, and inversely proportional to the square of velocity for fast particles. This tendency of the fast particles to overcome repulsion is a property connected with the "run-away" of electrons. A criterion for maximum friction is derived. The triplet interaction, which mainly affects the shielding phenomena, assures the convergence of the coefficients in case of distant interaction. Since the length scales of interaction are well determined in this way, the kinetic equation can be expected to be valid over a longer range than does the Boltzmann equation. The large scale agrees with the Debye radius, when the shielding term is linearized, as should be expected. When time relaxation is left aside and linearization is made, the kinetic equation degenerates to the classical Fokker-Planck equation with convergent coefficients.

List of Titles

Journal of Research, Section 63A, No. 3, November–December 1959. 70 cents.

Multiple ionization of rare gases by electron impact. M. Krauss, R. M. Reese, and V. H. Dibeler.
Light scattering by commercial sugar solutions. Carl J. Rieger and Frank G. Carpenter.
Analysis of the first spectrum of ruthenium (Ru I). K. G. Kessler.
Supplementary Zeeman data for the first spectrum of ruthenium (Ru I). J. Rand McNally, Jr., and K. G. Kessler.
Low even configurations in the first spectrum of ruthenium (Ru I), part 2. R. E. Trees.
Thermal degradation of polymers at high temperatures. Samuel L. Madorsky and Sidney Straus. Influence of impurities on the pyrolysis of polyamides. Sidney Straus and Leo A. Wall.
A preliminary list of levels and g-values for the first spectrum of thorium (Th I). Romuald Zalubas.
OH in the solar spectrum. Charlotte E. Moore and Herbert P. Broida.
Use of Chebychev polynomials in thin film computations. Klaus D. Mielenz. (See above abstracts.)

Journal of Research, Section 64A, No. 1, January–February 1960. 70 cents.

The "1958 He^4 scale of temperatures." F. G. Brickwedde. H. van Dijk, M. Durieux, J. R. Clement, and J. K. Logan.
Energy levels and spectrum of neutral helium (^{4}He I). William C. Martin.
Vibration-rotation structure in absorption bands for the calibration of spectrometers from 2 to 16 microns. Earle K. Plyler, Alfred Danti, L. R. Blaine, and E. D. Tidwell.
Combustion calorimetry with fluorine: constant pressure flame calorimetry. G. T. Armstrong and R. S. Jessup.
Pits in metals caused by collision with liquid drops and rigid steel spheres. Olive G. Engel.
Theory of formation of polymer crystals with folded chains in dilute solution. John I. Lauritzen, Jr., and John D. Hoffman. (See above abstracts.)
Studies of beryllium chromite and other beryllia compounds with R_2O_3 oxides. C. E. Weir and A. Van Valkenburg.
The uranium-platinum system. J. J. Park and D. P. Fickle.
Nitriding phenomena in titanium and the 6Al–4V titanium alloy. J. R. Cuthill, W. D. Hayes, and R. E. Seebold.
Stability of silver and Pyrex in perchloric acid-silver perchlorate solutions and in conductivity water. D. Norman Craig, Catherine A. Law, and Walter J. Hamer.
Note on the preparation of sodium amalgam in the form of pellets. H. S. Isbell, H. L. Frush, and N. B. Holt.

Journal of Research, Section 64C, No. 1, January–March 1960. 75 cents.

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